REMARKS

Claims 1-99 are pending in this application. Claims 1, 20, 26, 30, 34, 53, 59, 63, 67, 86, 92 and 96 have been amended. No new matter has been added.

At ¶2 of the Office Action, the Examiner rejects claims 1-99 under 35 U.S.C. §102(b) as being anticipated by Barrio, "Study of the techniques for emulation programming," The Technical University of Catalonia (UPC), Europe, pp. 1-152, 6-2001 (http://personals.ac.upc.edu/vmoya/docs/emuprog.pdf) (hereinafter "Barrio"). The Applicant traverses this rejection, and believes the pending claims are patentable over Barrio for at least the reasons set forth below. However, in the interest of expediting prosecution, the Applicant amends claims 1, 20, 26, 30, 34, 53, 59, 63, 67, 86, 92 and 96 to further clarify the claimed subject matter. These amendments are supported throughout the specification, for example at paragraphs [0040] to [0043] and [0045], and by Figures 5 and 6.

The Applicant sets forth the following arguments below in particular for independent claims 1, 20, 26 and 30. However, those arguments also apply to independent claims 34, 53, 59, 63, 67, 86, 92 and 96.

CLAIM 1

As amended, claim 1 recites the step of, "*comparing execution of the subject code natively on the subject processor against execution of the same subject code on the same subject processor through the emulator at the comparable point in the subject code*". Barrio clearly neither teaches nor suggests this limitation. Therefore claim 1 as amended is allowable, and this rejection should be withdrawn.

In particular, the Examiner asserts that claim 1 is anticipated by the disclosure of Barrio at page 24, section 8: "Testing the emulator". In particular, the Examiner argues that step (a) of claim 1 is disclosed by "*to properly test aCPU emulator it would mean to generate all the possible instructions which can receive a CPU*", that step (b) of claim 1 is disclosed "*and compare the result*" and that step (c) is disclosed by "*in the emulator with the real result*".

Please refer to Figures A and B below to help illustrate the differences between Barrio and claim 1. Figure A illustrates particularly steps (a) and (b) as recited by claim 1. Figure B illustrates the type of emulators and the testing of emulators as taught by Barrio.
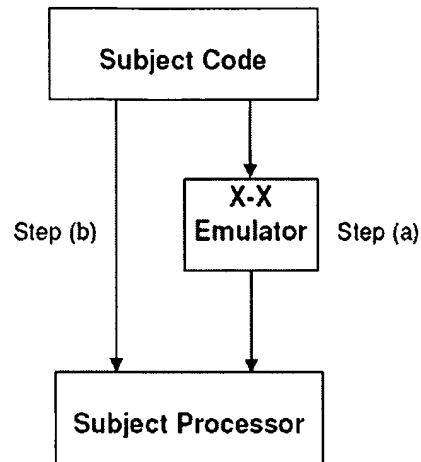
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        ┌──────────────────┐                      ┌────────┐   ┌────────┐
        │   Subject Code   │                      │  Test  │   │  Test  │
        └──────────────────┘                      │  Code  │   │  Code  │
            │         │                            └────────┘   └────────┘
            │      ┌──────────┐                        │            │
            │      │   X-X    │                        │        ┌──────────┐
  Step (b)  │      │ Emulator │  Step (a)              │        │  X to Y  │
            │      └──────────┘                        │        │ Emulator │
            │         │                                │        └──────────┘
            ▼         ▼                                ▼            ▼
        ┌──────────────────┐                      ┌────────┐   ┌────────┐
        │ Subject Processor│                      │ X-type │   │ Y-type │
        └──────────────────┘                      │Real CPU│   │Host CPU│
                                                  └────────┘   └────────┘
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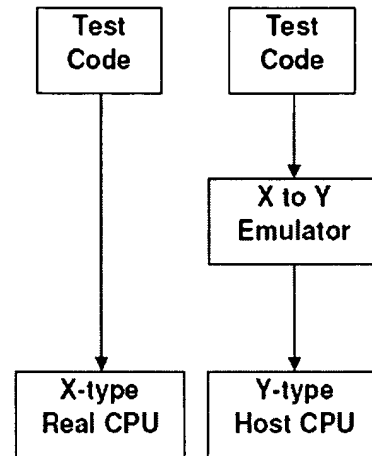**Figure A –Graphical representation of claim 1**   **Figure B – Graphical representation of**
Barrio

Claim 1 requires "*comparing execution of the subject code natively on the subject processor against execution of the* ***same*** *subject code on the* ***same*** *subject processor*". That is, as illustrated in Figure A, the native execution and the emulated execution are both run on the same hardware.

By contrast, as illustrated in Figure B above, Barrio only teaches the use of separate hardware. Barrio discloses at page 10, paragraph 2, that "*the kind of emulators which this document talks about are software emulators of computers. A software computer emulator has to emulate all the components of a real computer using software programs over* ***another*** *computer*".

According to Barrio, the "*best manner for testing a CPU emulator is to run it* ***hand by*** ***hand*** *with a real CPU and look for differences*" (see page 62). Therefore, the person of ordinary skill is taught by Barrio that the best way of verifying an emulator is to use separate hardware as illustrated in our Figure B above.

Therefore, the Applicant respectfully submits that the cited passage on page 24, section 8 relied on by the Examiner in rejecting claim 1 should be construed as follows: to properly test a CPU emulator it would mean to generate all the possible instructions which can receive a CPU and compare the result in the emulator **running on one computer** with the real result **output from a different computer**.

Thus, the Applicant respectfully submits that the disclosure of Barrio does <u>not</u> anticipate the method of claim 1.

The Applicant respectfully submits that with such explicit teachings there is no incentive for the person of ordinary skill to adapt the teachings of Barrio. Thus, the Applicant respectfully submits that Barrio does not render claim 1 obvious.

Here, we note that Barrio specifically states at page 24, section 8 that this form exhaustive testing "*is a **hard task**, or in some cases an **impossible** task*". Thus, Barrio teaches away from claim 1 by specifically acknowledging that this form of testing is very difficult and in some cases is simply an impossible task.

By contrast, the Applicant describes and claims a new and non-obvious method to test an emulator by – unlike Barrio – running the emulator on the <u>same subject hardware</u> as the native execution. Importantly, this surprising advance over the prior art enables full and accurate testing of the emulator in a way that Barrio explicitly fails to achieve.

CLAIM 20

Amended claim 20 is allowable for the same reasons as claim 1. Further, claim 20 recites the step of, "*comparing the emulated machine <u>state contained in the load/store buffer</u> against the native machine <u>state contained in the memory</u> to verify the program code conversion*" which is <u>not</u> disclosed in Barrio. The rejection of claim 20 as amended should be withdrawn.

In particular, the Examiner asserts that Barrio anticipates claim 20, reciting the same passage as for claim 1. Here, the same observations for claim 1 apply to the method of claim 20.

Additionally, new claim 20 requires storing an emulated machine state *"in a load/store buffer associated with the same subject processor"*.

Executing the same code natively and through the emulator on the same hardware leads to a problem in that the native execution may well trample over changes to memory made by the preceding emulated execution. However, as recited by claim 20, this aspect of the claimed invention allows both native and emulated execution to occur on the same hardware but <u>without</u> trampling or collision, by storing a native machine state in memory and an emulated machine state (i.e. an emulated version of the state of the subject processor) in the load/store buffer - and then efficiently comparing the two executions by *"comparing the emulated machine state contained in the load/store buffer against the native machine state contained in the memory to verify the program code conversion"*.

The Examiner argues that Barrio discloses the use of a load/store buffer for this purpose in Figure 21 and page 41. However, a careful reading of Barrio shows that Figure 21 is in a section entitled "Memory." This section discloses how to emulate memory and Barrio refers to Figure 21 as a way of emulating memory. This section does not disclose how to use memory associated with a subject processor to verify an emulator. Therefore, Barrio does not disclose a method that includes using a load/store buffer to store an emulated machine state as in claim 20. Thus, the Applicant respectfully submits that Barrio does not anticipate claim 20.

Furthermore, Barrio contains no teachings relevant to using a load/store buffer associated with the same subject processor for verifying an emulator. Therefore, Barrio contains no motivation for the person of ordinary skill to consider <u>using a load/store buffer to store an emulated machine state</u> as in claim 20. Thus, the Applicant respectfully submits that Barrio does not render claim 20 obvious.

28

CLAIM 26

Amended claim 26 is allowable for the same reasons as set forth above for claim 1.

Further, claim 26 recites a two-stage validation process of:

> *"first comparing execution of subject code natively on a subject processor against execution of the **same** subject code on the **same** subject processor through a first emulator"*

and then secondly:

> *"comparing execution of subject code through the first emulator running on the subject processor against execution of the **same** subject code through a second emulator running on a **target** processor".*

This two-stage incremental validation process is not taught or suggested by Barrio. The rejection of claim 26 as amended should therefore be withdrawn.

In particular, claim 26 recites the step of:

> *"first comparing execution of subject code natively on a subject processor against execution of the **same** subject code on the **same** subject processor through a first emulator, thereby verifying program code conversion performed by the first emulator".*

This method step is similar to claim 1. The first emulator required by claim 26 is clearly not the type of emulator disclosed by Barrio. Thus, the Applicant respectfully submits that Barrio does not anticipate the step quoted above of *"first comparing ... thereby verifying ... the first emulator"* as required by claim 26.

Therefore, for at least the reasons submitted for claim 1, claim 26 should be allowable. Additionally, claim 26 clearly recites a <u>two-stage</u> verification process, which is not taught by Barrio.

That is, claim 26 requires:

> *"next comparing execution of subject code <u>through the first emulator</u> running on the subject processor against execution of the same subject code <u>through a second emulator</u> running on a target processor, thereby verifying program code conversion performed by the second emulator <u>using the verified program code conversion performed by the first</u> <u>emulator</u>".*

29

As the Examiner notes, Barrio does mention that *"a good alternative is to compare the execution of our CPU emulator with another, trusted CPU emulator"* (see page 62). However, Barrio here only teaches a <u>one-stage</u> test of comparing <u>two different</u> X-to-Y type emulators. The one-stage test of comparing of emulators disclosed by Barrio does not anticipate the specific two stage verification method recited in claim 26.

Further, Barrio does not teach or suggest anything that would lead the person of ordinary skill to consider providing a method as recited by claim 26. Thus, the Applicant also respectfully submits that Barrio does not render claim 26 obvious.

CLAIM 30

Amended claim 30 is allowable for the same reasons as set forth above for claim 1.Further, claim 30 recites the <u>two-stage</u> validation process similar to claim 26, but with the additional limitations of, *"dividing the subject code into a plurality of blocks ... comparing execution of the block ... natively on a subject processor against the execution ... through the first emulator; [and then] comparing execution of the same block through a second emulator ... against the already verified execution ... through the first emulator ... and repeating for every block of the subject code ..."*. Again, this block-by-block two-stage incremental validation process is not taught or suggested by Barrio. The rejection of claim 26 as amended should therefore be withdrawn.

<u>CLAIMS 34, 53, 59, 63, 67, 86, 92 and 96</u>

The arguments set forth above also apply to independent claims 34, 53, 59, 63, 67, 86, 92 and 96, so the Applicant submits that those claims should also be allowable.

DEPENDENT CLAIMS

Dependent claims 2-19, 21-25, 27-29, 31-33, 35-52, 54-58, 60-62, 64-66, 68-85, 87-91, 93-95 and 96-99 all depend from allowable base claims, so they should also be allowable.
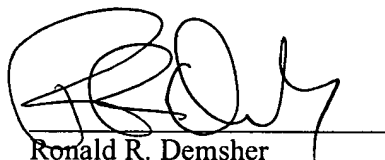
CONCLUSION

The pending Office Action was mailed on December 15, 2006, so the statutory period for response expires on March 15, 2007. Accordingly, Applicant respectfully submits that this response is being timely filed.

In view of the above amendment, applicant believes the pending application is in condition for allowance. No other fees are believed to be due in connection with the filing of this response, however the Commissioner is authorized to debit Deposit Account No. 08-0219 for any required fee necessary to maintain the pendency of this application.

Respectfully submitted,

Dated: March 13, 2007

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